

### REMARKS

By the present Amendment, claims 15-23 are cancelled and claims 24-42 are added. This leaves claims 24-42 pending in the application, with claims 24, 32 and 35 being independent.

#### Substitute Specification

The specification is revised to eliminate grammatical and idiomatic errors in the originally presented specification. The number and nature of the changes made in the specification would render it difficult to consider the case and to arrange the papers for printing or copying. Thus, the substitute specification will facilitate processing of the application. The substitute specification includes no "new matter". Pursuant to M.P.E.P. § 608.01(q), voluntarily filed, substitute specifications under these circumstances should normally be accepted. A marked-up copy of the original specification is appended hereto.

#### Rejections Under 35 U.S.C. § 112

Previously presented claims 15-23 stand rejected under 35 U.S.C. § 112, second paragraph as being indefinite. In newly submitted claims, each structural limitation is clearly and positively recited, and is organized and correlated to present a complete and operative device. All terminology is provided with proper antecedent basis and is clearly recited. No combination of a broad range and a narrow limitation is alternatively recited within a single claim.

Accordingly, the presently pending claims are definite and comply with the requirements of 35 U.S.C. § 112.

### Rejections Under 35 U.S.C. § 102 and 103

Newly submitted claim 24 includes the limitations of previously presented claims 15 and 18 and constitutes claim 18 rewritten in independent form including all of the limitations of the base claim and any dependent claims, as well as avoiding the rejections under 35 U.S.C. § 112, second paragraph, as noted above. In view of paragraph 6 of the Office Action indicating that such claim would be allowable, claim 24, as well as claims 25-31 which depend directly or indirectly thereon, are also allowable. The record will not be burdened with further comments regarding claims 24-31.

Claim 32 covers a rivet for use in a device for producing a riveted joint in which the device has means for driving the rivet through workpieces to be joined and has means for pulling the rivet. The rivet comprises a rivet jacket 14a and a rivet pin 14b tightly connected to and received within the rivet jacket. A pyramid shaped point 14c is on the first axial end of the rivet pin facing the workpieces. Catch means are provided on the exterior surface of the rivet pin and on the exterior surface of the rivet jacket. The catch means on each of the rivet jacket and the rivet pin include annular surfaces substantially perpendicular to longitudinal axes of the rivet pin and the rivet jacket and angled surfaces extending from the annular surfaces and tapering a direction away from the first end.

By forming the rivet in this manner, the rivet pin positively and securely latches to the rivet jacket by engagement of the respective annular surfaces during driving of the rivet through the workpiece.

Relative to previous claims 22 and 23 directed to the rivet, German Patent No. 23 34 385 and U.S. Patent No. 4,990,042 to Szayer have been cited and applied in a rejection of those

previously presented claims. However, none of these patents appear to have the specific catch arrangement structure recited in claim 32.

Claims 33 and 34 being dependent upon claim 32 are also allowable for the above reasons. Moreover, these dependent claims recite additional features further distinguishing them over the cited patents. Specifically, the tapered second end and the pyramid shaped second end of claims 33 and 34, respectively, are not anticipated are rendered obvious, particularly within the overall claim combination.

Claim 35 covers a device for producing a riveted joint with a rivet having a rivet jacket and a rivet pin received within the rivet jacket. The device comprises a means for driving the rivet through workpieces to be joined and means for pulling the rivet. The means for driving the rivet include a cylindrical part with a firing channel 70, a firing bolt 25 receivable in the firing channel and a cylindrical striking member 21 arranged between the rivet and the firing bolt and impacted by the firing bolt. A first flexible element 51 in the cylindrical part biases the striking member against the rivet pin.

Previous claims 15-17 stand rejected under 35 U.S.C. § 102 as being anticipated by British Patent No. 1,128,442. The British patent is cited as disclosing a device with a firing bolt 39, a striking member 26, 27, 30 and 33 and a flexible element or spring 37. British patent member 35 and 38 is viewed as a centering means. British patent member 34 is interpreted as buffering means.

However, if the striking member is interpreted as including spindle 26, abutment shoulders 27, tubular housing 30 and spring arms 33, spring 37 does not bias that striking member against the rivet pin and is not in a cylindrical part, particularly since a significant portion of the striking


member is beyond the spring. The British patent spring 34, as disclosed on page 3, lines 106-113, operates between block 34 of the collet and the forward end of screw extension 29 to bias the collet forwardly in which the tapered jaws 35 grip the mandrel. Thus, the spring does not bias or hold the striking member, as recited in claim 35.

Accordingly, claim 35 is not anticipated or rendered obvious by the cited British patent.

Claims 36-42, being dependent upon claim 35, are also allowable for the above reasons. Moreover, these dependent claims recite additional features further distinguishing them over the cited patents. Specifically, the flexible member being a helical spring of claim 36, the centering device of claim 37, the buffer element of claim 38, the specific pulling means of claims 39 and 40, the compressed air connection, hydraulic/pneumatic pressure converter, evacuation valve and pneumatic switch of claim 41, and the handle of claim 42, are not anticipated or rendered obvious by the cited patents, particularly within the overall claimed combination.

In view of the foregoing, claims 24-42 are allowable. Prompt and favorable action is solicited.

Respectfully submitted,

  
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Patent Application

of

SVEN RÖTHE

and

KLAUS WIRTH

for

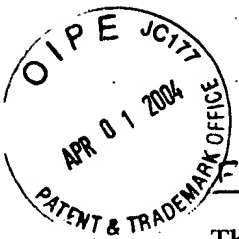
DEVICE FOR PRODUCING A RIVETED  
JOINT AND CORRESPONDING RIVET

**Field of the Invention**

[0001] The present invention relates to a device for producing a riveted joint with means for firing the rivet and means for pulling the rivet, as well as a rivet suitable for use with this device.

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Patent Application  
of  
SVEN RÖTHE  
and  
KLAUS WIRTH  
for



Device for Producing a Riveted Joint and Corresponding Rivet

all caps

Field of the Invention  
present

The invention relates to a device for producing a riveted joint with means for firing the rivet and means for pulling the rivet, ~~as disclosed in the disclosure part of Claim 1~~ as well as a rivet suitable for use with this device.

Background of the Invention

Riveted joints ~~of this type~~ <sup>and</sup> are already known and used for the joining of workpieces, especially sheets of metal, particularly when the workpieces to be joined are accessible from only one side. Typical uses of the riveted joint are the assembly of metal fittings, walls of cassettes or disk holders or border parts on insulation panels in industry and in the construction of large halls or gymnasiums. The sheet metal pieces to be joined are of a thickness of approximately 0.1 mm to approximately 3 mm, <sup>of</sup> and typically approximately 0.75 mm.

For the mounting of the rivet, made up of <sup>though a borehole in the workpieces</sup> a rivet jacket and a rivet pin guided through the rivet jacket, the workpieces are first penetrated <sup>and</sup> the rivet with rivet jacket is pressed forward and through as far as impact of the striking head of the rivet jacket on the edge of the borehole ~~inside the borehole~~. For production of the riveted joint between the workpieces then with holding back of the striking head, the rivet pin is drawn counter to the pressing-in direction, <sup>thereby</sup> whereby the end of the rivet jacket lying opposite the striking head is deformed, allowing for the formation of a widened out part, so that the workpieces to be joined together are held together between the striking head and the widening out which has been produced. ~~This type of the riveting is frequently also known as "blind riveting." EP 0 302 128 B1 discloses a tool for drawing out or setting of blind rivets. Even with use of such a tool a preliminary borehole and insertion of the blind rivet is still required.~~

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*discloses*  
This type of rivet is frequently also called a "blind rivet". EP 0 302 128 B1 ~~shows~~ a tool for the pulling or setting of blind rivets. *For* Also with use of such a tool, a preliminary borehole and insertion of the blind rivet are still required.

*disclosed*  
WO 95/05255 ~~shows~~ a device for production of a riveted joint with pneumatically driven means for the firing of a rivet through the workpieces to be joined and pneumatically driven means for the subsequent pulling of the rivet. The means for the firing of the rivet in this case incorporate a conically tapering, hollow cylindrical driving-in part on the striking head of the rivet jacket. The rivet pin is guided through an opening in the striking surface of the driving-in part which is turned toward the striking head of the rivet in the interior of the driving-in part, and at that point is picked up by the means arranged to the rear of the driving-in part in the firing direction for the pulling of the rivet. The outlay for construction required by the arrangement of the means for the pulling of the rivet within the hollow cylindrical volume formed by the means for the firing of the rivet is considerable for such a device, especially because it requires the maintenance of *small* ~~low~~ manufacturing tolerances *for* ~~with reference to~~ the means for pulling the rivet. Also, this arrangement requires a large structure for the entire assembly.

*disclosed*  
GB-A-1,128,442 ~~shows~~ a device for producing a riveted joint with means for the driving of a rivet having a rivet jacket and a rivet pin guided through the rivet jacket through workpieces to be joined and with means for the pulling of the rivet, ~~whereby~~ *whereby* the means for the driving-in of the rivet act on the rivet pin, and have a firing bolt in a cylindrical part and a cylindrical striking member arranged between the rivet and the firing bolt,

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which has a shoulder on which the firing bolt impacts. ~~When~~ during insertion into the device, the rivet with its rivet pin is guided in insufficiently far to form contact on a contact strip of the striking member and/or through the manipulation of the device ~~and~~ the movements of the rivet pin connected ~~therewith~~ <sup>the device</sup> is moved away from the contact strip. <sup>occurs</sup> During the driving-in process, ~~there occurs~~ <sup>impact</sup> an impact of the striking member on the rivet pin. This frequently leads to an undesired deformation of the rivet pin and/or to damage of the striking member.

DE 295 14 392 U1 <sup>discloses</sup> ~~shows~~ a rivet in which the rivet jacket is stopped on the rivet pin, wherein <sup>discloses</sup> especially, the rivet jacket is stopped between convexities constructed between the rivet pin and the rivet head, ~~and~~ the rivet pin has a conical point on its first end turned toward the workpieces. With driving in of such a rivet, the driving-in force is exerted on the rivet jacket. ~~With the use of a such a rivet with a device of the invention,~~ <sup>the disclosure</sup> in which the means for the driving-in of the rivet work on the rivet pin, the rivet pin is forced through the rivet jacket, whereupon no riveted joint can be produced.

#### Summary of the Invention

<sup>are to provide</sup>  
~~Objects of the~~ The present invention ~~therefore addresses the problem of preparing a device for~~ <sup>conventional devices</sup> producing a riveted joint which overcomes the drawbacks of ~~the state of the art and~~ <sup>especially</sup> which prevents the deformation of the rivet pin and/or of the striking member, and thus provides a higher level of operational security and a longer life of the device.  
<sup>Other objects of the present invention are to provide such</sup> ~~Therefore the device is to be produced at low cost and guarantees reliable operation.~~

The outlay for the construction for the preparation of the means for the pulling and

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means for the firing of the rivet is thus to be as small as possible, and especially <sup>with</sup> a realization ~~is to be facilitated which is of~~ as small as possible structural dimensions. Also, a rivet which can be processed using this device is to be prepared for use.

~~The problem is solved by the device disclosed in Claim 1. A suitable rivet is specified in the following claim. Special embodiments of the invention are specified in the dependent claims.~~

*The foregoing objects are basically obtained by a device where it*  
~~The problem is solved in that the~~ striking member is held <sup>in the cylindrical part by a</sup> flexible element, especially by a first helical spring in axial contact on the rivet pin. This arrangement provides the advantage that the striking member already engages on the rivet pin when the firing bolt impacts on the striking member. Thus any damage, particularly bending, of the rivet pin and of the striking member is reliably prevented on the basis of an impacting of the striking member on the rivet pin. Furthermore, ~~then also~~ a dropping of the torn-off rivet pin into the firing channel is prevented, ~~and the device~~ can be operated in any position, ~~and particularly,~~ rivets can even be arranged facing vertically upward.

~~Owing to the fact that~~ <sup>Since</sup> the means for the driving-in or firing of the rivet act on the rivet pin, the means for the pulling of the rivet can advantageously engage <sup>the</sup> in firing direction before the means for the firing of the rivet on the rivet pin. The constructive configuration of space allowed for the realization of the means for pulling the rivet is thus greater, and a corresponding device of small dimensions can be easily realized. The firing of the rivet with acting upon the rivet pin then increases the reliability of the rivet joint <sup>at</sup> being produced, since a certain penetration of the workpieces to be joined

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is guaranteed by means of the rivet pin. The means for the firing and means for the pulling of the rivet can be powered pneumatically, hydraulically, magnetically, electrically, piezoelectrically or with use of some means of explosion.

~~Since~~ But  
~~Owing to the fact of~~ the "interposition" of a cylindrical striking member between the firing bolt and the rivet, the reliability of the firing process and with that the reliability of the riveted joint itself is heightened, the striking member can ~~thus~~ <sup>then</sup> be made up of a first segment ~~of which the diameter is adapted to the diameter of the firing channel and a second segment of which the smaller diameter is adapted to the diameter of the rivet pin, and particularly can be of approximately identical diameter up to 1.5-times the diameter of the rivet pin.~~ <sup>with</sup> ~~the second segment~~ <sup>with</sup>

~~The device of Claim 2 provides the advantage that the~~ reliability of the firing process is even further heightened by having the centering device adapted to the ~~for example~~ trough-like or depressed shape of the end of the rivet pin which is adjacent to the striking member. Of particular importance, the traditionally desirable rectangular alignment of the rivet pin in relation to the workpieces to be joined and the corresponding guiding of the rivet during the firing process is guaranteed.

~~The device according to Claim 3 offers the advantage that the~~ movement of the striking member at the end of the firing process is smoothly suppressed by the flexible buffer element and especially does not impinge on the end of the preferably metallic firing channel. The service life of the device is thus significantly increased. The buffer element engages preferably on an annular shoulder at the end of the firing channel, which is formed by an opening in the firing channel. ✓

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~~and~~ For example, <sup>the buffer element</sup> can be embodied as <sup>La</sup> helical spring, disk spring or rubber or plastic washer.

The ~~device according to Claim 4 offers the advantage that~~ the firing channel can be made easily accessible as a result of the two-part configuration of the firing channel being formed by a hollow piston and a connecting member which preferably are screwed together, ~~and especially in that case,~~ the striking member can be exchanged when necessary.

The ~~device according to Claim 5 offers the advantage that not only is the~~ guiding of the rivet pin during the firing and pulling process <sup>can be</sup> obtained through the end piece, <sup>Also,</sup> ~~but that~~ the end piece simultaneously executes a spreading of the clamping jaws during the firing process, <sup>Such action</sup> and with that allows a friction-free passage of the rivet pin, and if necessary, of the striking member through the clamping jaws during the firing process. Any damage to the clamping jaws and potentially to the striking member is simultaneously and reliably prevented by the rivet pin during the firing process. Also, the introduction of a new rivet is simplified by the spreading of the clamping jaws. The second flexible element can be configured as a helical spring. Alternatively, ~~to that~~ for example, a disk spring or a rubber or plastic washer can be used.

The ~~device according to Claim 6 offers the advantage that by having the~~ piston, joining member and clamp sheathing <sup>can be</sup> connected with one another, preferably by being screwed together with one another, <sup>A</sup> pulling of the rivet pin by means of the stress of the pressure of the piston counter to the force effect of a flexible element, preferably a helical <sup>spring</sup> screw with high elasticity constant, a reliable

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pulling of the rivet and with that a reliable production of the riveted joint <sup>then</sup> are guaranteed. The pressure is preferably applied by using hydraulic pressure in order to generate the required high pressure forces.

The ~~device as in Claim 7 offers the advantage that the device~~ <sup>can</sup> require only one auxiliary connection, in the form of a compressed air connection. The hydraulic pressure is generated through a pneumatic/hydraulic pressure converter. The rivet is fired pneumatically. <sup>The rivet is pulled off hydraulically.</sup> The entire riveting process including firing and pulling is controlled by a three-stage pneumatic switch element. The pneumatic/hydraulic pressure converter, the same as the rapid evacuation valve, is preferably mounted in a handle of the device.

A rivet ~~according to Claim 8 is~~ <sup>can be</sup> provided for use in the device according to the <sup>present</sup> invention. With the pyramid-shaped point of the rivet pin, for example, four cutting edges are formed, <sup>and</sup> which simplify penetration of the workpieces. By the provision of catch means directed toward the point of the rivet, any <sup>relative</sup> movement of the rivet ~~in relation~~ to the rivet jacket, especially during the firing process of the rivet, is reliably prevented. The catching means could, ~~thus~~ <sup>for example</sup>, be realized by pins projecting radially and ~~arranged~~ distributed around the periphery of the rivet pin, or by truncated conical partial segments of the rivet pin produced by rollers and arranged in axial alignment one behind the other.

<sup>Since</sup> ~~Owing to the fact that~~ the rivet jacket is connected tightly with the rivet pin, and preferably is extruded thereon, the rivet pin will not be moved, or at least will not be moved remarkably relative to the rivet jacket ~~especially~~ during the firing process

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~~advantageous~~ <sup>present</sup> with use of the rivet in a device according to the invention, ~~since~~ <sup>present</sup> with the device according to the invention, the means for firing the rivet act on the rivet pin. The rivet pin is preferably of steel or stainless steel. The rivet jacket can likewise be of steel or stainless steel, or alternatively of an aluminum or copper alloy. Upon deformation of the point, penetration of the workpieces is still possible even when using low firing energy. The point can be configured conical or, if desired, can be ogival, and especially the point can also have one or more cutting edges. The point angle is preferably configured in a range of 30 to 60°.

The ~~rivet as in Claim 9 offers the advantage that~~ cooperation with the centering device on the striking member is specifically guaranteed by the tapering second end of the rivet pin. A configuration of the second end in the shape of a pyramid is advantageously obtained by suitable separation of a rivet pin from a rod-shaped starting material.

(A) → ~~Other advantages, features and individual points relating to the invention are disclosed in the dependent claims as well as in the following description with reference to the drawings showing one exemplary embodiment in some detail. Thus the selected features indicated in the claims and in the description can be protected individually in turn in and of themselves or in any desired combination considered as relating to the invention.~~

~~Fig. 1~~ shows a section through the head part of the device according to the invention,

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(A)  
for p. 7a

Other objects, advantages and salient features of the present invention will become apparent from the following detailed description, which, taken in conjunction with the annexed drawings, discloses <sup>a</sup> preferred embodiment~~s~~ of the present invention.

#### Brief Description Of The Drawings

Referring to the drawings which form a part of this disclosure:

Figure 1 is a side elevational view in section of ~~a head part of a device~~  
~~an apparatus for~~  
according to a ~~first~~ embodiment of the present invention;

✓ ✓ ✓  
Figure 2 is a <sup>side elevational</sup> ~~top plan~~ view in section of ~~the~~  
~~of a handle of the device~~  
~~apparatus taken along line A-A of Figure 1;~~

Figure 3 is a side elevational view <sup>partially cut away</sup> ~~in section of~~  
~~of the entire device of Figure 1; and~~  
~~an apparatus~~  
~~according to a second embodiment of the present invention; and~~

Figure 4 is a side elevational view in section of ~~a rivet for use in the device of Figure 1.~~  
~~an apparatus for~~  
~~according to a third embodiment of the present invention.~~

(B)  
for p. 14

While <sup>one</sup> ~~various~~ embodiments <sup>S</sup> have been chosen to illustrate the invention, it will be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims.

~~Fig. 2 shows a section through the handle of the device according to the invention,~~

~~Fig. 3 shows a diagrammatic and partially cutout view of the entire device according to the invention, and~~

~~Fig. 4 shows a rivet for use in the device according to the invention.~~

~~Fig. 1 shows a section through the head part of the device according to the invention, which device is responsible for the firing and pulling of the rivet. The housing 1 of the device is represented at the right edge of the drawing, on which housing with use of a first packing O-ring 2 and a glass shield 24 the first cylinder 22 is screwed on by means of cylindrical screw 6 and supporting disks or washers 23. Likewise on the right edge of the drawing is represented the pneumatic cylinder 58 with the firing bolt 25 and the first buffer 50. Firing channel 70 extends in axial extension of firing bolt 25 and is /formed/ by the centering piece 45.~~

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~~WO 95/05253 shows a device for production of a riveted joint with pneumatically driven means~~  
for the firing of a rivet through the workpieces to be joined and pneumatically driven means for the subsequent pulling of the rivet. The means for the firing of the rivet in this case incorporate a conically tapering, hollow cylindrical driving-in part on the striking head of the rivet jacket. The rivet pin is guided through an opening in the striking surface of the driving-in part which is turned toward the striking head of the rivet in the interior of the driving-in part, and at that point is picked up by the means arranged to the rear of the driving-in part in the firing direction for the pulling of the rivet. The outlay for construction required by the arrangement of the means for the pulling of the rivet within the hollow cylindrical volume formed by the means for the firing of the rivet is considerable for such a device, especially because it requires the reliable operation of such a device while using high quality materials and also requires the maintenance of low manufacturing tolerances with reference to the means for pulling the rivet. Also this arrangement requires a large structure for the entire assembly.

The object of the present invention relates to the problem of manufacturing a device for producing a riveted joint which can be manufactured at low cost and which still guarantees reliable operation. The outlay for construction for the manufacture and preparation of means for the firing of the rivet is therefore to be held as low as possible, and a realization with smaller structural dimensions than is customary is to be possible. Also a rivet is to be developed and manufactured which can be processed using this device.

The problem is solved by the device disclosed in Claim 1. A suitable rivet is described in Claim 10. Specific embodiments of the invention are described in the dependent claims.

The problem is solved using a device as in Claim 1 in that the means for the driving-in or pulling of the rivet act on the rivet pin. Thus it is possible that the means for the pulling of the rivet



~~engage advantageously in the firing direction before the means for the firing of the rivet on the~~  
rivet pin. The constructive configuration showing room for some play in the realization of the means for pulling of the rivet is then more extensive and at the same time a suitable device can be realized which is small and easy to manufacture. The firing of the rivet by means of force being applied to the rivet pin also heightens the reliability of the riveted joint which is then produced, since a sure penetration of the workpieces to be joined by means of the rivet pin is then guaranteed. The means for firing the rivet and means for pulling the rivet can be powered pneumatically, hydraulically, magnetically, electrically, piezoelectrically or with use of explosive means.

The device according to Claim 2 offers the advantage that the reliability of the firing process and with that the reliability of the riveted joint itself is heightened by the interposition of a cylindrical striking member between the firing bolt and the rivet. The striking member can thus be made up of a first segment of which the diameter is adapted to the diameter of the firing channel and a second segment of which the smaller diameter is adapted to the diameter of the rivet pin, and particularly can be of approximately identical diameter up to 1.5-times the diameter of the rivet pin.

The device as in Claim 3 offers the advantage that the reliability of the firing process is further heightened by the centering device which may be synclinal and is adapted to the end of the rivet pin turned toward the striking member. Of particular importance, the traditionally desirable rectangular alignment of the rivet pin in relation to the workpieces to be joined and the corresponding guiding of the rivet during the firing process is guaranteed.

The device according to Claim 4 has the advantage that the striking member is already engaged ~~on the rivet pin when the firing bolt impacts on the striking member. Thus any damage~~

~~especially bending, of the rivet pin and of the striking member because of an impact of the~~  
striking member on the rivet pin is reliably prevented. Furthermore a falling of the torn off rivet pin into the firing channel is thus also prevented, and the device can be operated in any setting, especially in that rivets can even be set up facing upward.

The device according to Claim 5 offers the advantage that the movement of the striking member at the end of the firing process is smoothly suppressed by the flexible buffer element and especially does not impinge on the end of the firing channel which is preferably of metallic configuration. The service life of the device is thus significantly increased. The buffer element preferably engages on an annular shoulder at the end of the firing channel which is formed by an opening in the firing channel, and the buffer can for example be configured as helical spring, disk spring or rubber or plastic washer.

The device of Claim 6 offers the advantage that the firing channel can be made easily accessible as a result of the two-part configuration of the firing channel formed by a hollow piston and a connecting member, which preferably are screwed together, and especially in that case the striking member can be exchanged when necessary.

The device according to Claim 7 offers the advantage that not only is the guiding of the rivet pin during the firing and pulling process obtained through the end piece, but that the end piece simultaneously executes a spreading of the clamping jaws during the firing process and with that allows a friction-free passage of the rivet pin and if necessary of the striking member through the clamping jaws during the firing process. Any damage to the clamping jaws and potentially to the striking member is simultaneously and reliably prevented by the rivet pin during the firing process. Also the introduction of a new rivet is simplified by the spreading of the clamping jaws.

~~The second flexible element can be configured as a helical spring. Alternatively to that for~~

~~example a disk spring or a rubber or plastic washer can be used.~~

The device according to Claim 8 offers the advantage that by having the piston, joining member and clamp sheathing connected with one another, preferably by being screwed together with one another, a pulling of the rivet pin by means of the stress of the pressure of the piston counter to the force effect of a flexible element, preferably a helical screw with high elasticity constant, a reliable pulling of the rivet and with that a reliable production of the riveted joint are guaranteed. The pressure is preferably applied by using hydraulic pressure in order to generate the required high pressure forces.

The device as in Claim 9 offers the advantage that the device requires only one auxiliary connection, which is a compressed air connection. The preparation of the hydraulic pressure occurs through a pneumatic/hydraulic pressure converter. The rivet is fired pneumatically; the rivet is pulled off hydraulically. The entire riveting process including firing and pulling is controlled by a three-stage pneumatic switch element. The pneumatic/hydraulic pressure converter the same as the rapid evacuation or pressure release valve is preferably mounted in a handle of the device.

A rivet is described in Claim 10 for use in the device according to the invention. Here it is proven advantageous that the rivet jacket be connected securely with the rivet pin, preferably by being extruded thereon. Thus it is assured that the rivet pin will not be moved or at least will not be moved remarkably relative to the rivet jacket especially during the firing process. This is especially advantageous with use of the rivet in a device according to the invention, since with the device of the invention the means for firing the rivet act on the rivet pin. The rivet pin is preferably of steel or stainless steel. The rivet jacket can likewise be of steel or stainless steel or ~~alternatively can be of an aluminum or copper alloy.~~

~~The rivet of Claim 11 offers the advantage that by the shaping of a point, penetration of the~~  
workpiece is possible even with low firing power. The point can thus be configured conical or if  
desired can be ogival, and more particularly the point can also have one or more cutting edges.  
The point angle configuration is preferably in a range of between 30 and 60°.

The rivet of Claim 12 has the advantage that a total of four cutting edges are formed by the  
pyramid configuration, which simplifies the penetration of workpieces.

The rivet as in Claim 13 has the advantage that cooperation with the centering device on the  
striking member is specifically guaranteed by the tapering second end of the rivet pin. A  
configuration of the second end in the shape of a pyramid is advantageously obtained by suitable  
separation of a rivet pin from a rod-shaped starting material.

The rivet according to Claim 14 has the advantage that by the provision of catching means  
directed toward the point of the rivet, any relative movement of the rivet pin in relation to the  
rivet jacket especially during the firing process of the rivet is reliably prevented. The catching  
means then can for example be realized by pins extending radially and distributed around the  
periphery of the rivet pin or by partial segments of the rivet pin which are truncated conically-  
shaped, arranged one behind the other in axial direction, and produced by rollers.

Other advantages, features and individual points relating to the invention are disclosed in the  
dependent claims as well as the following description with reference to the drawings showing  
one exemplary embodiment in some detail. Thus the selected features indicated in the claims  
and in the description can be protected individually in turn in and of themselves or in any desired  
combination considered as relating to the invention.

Fig. 1 shows a section through the head part of the device according to the invention,

Fig. 2 shows a section through the handle of the device according to the invention,

Fig. 3 shows a diagrammatic and partially cutout view of the entire device according to the invention, and

Fig. 4 shows a rivet for use in the device according to the invention.

### Detailed Description of the Invention

Fig. 1 shows a section through the head part of the device, according to the <sup>present</sup> invention, which device is responsible for the firing and pulling of the rivet. The housing 1 of the device is represented at the right edge of the drawing, <sup>By</sup> on which housing with use of a first packing O-ring 2 and a glass shield 24, the first cylinder 22 is screwed on <sup>the housing with</sup> by means of cylindrical screw 6 and supporting disks or washers 23. <sup>is illustrated</sup> Likewise on the right edge of the drawing is represented the pneumatic cylinder 58 with the firing bolt 25 and the first buffer 50. Firing channel 70 extends in axial extension of firing bolt 25, and is formed by the centering member 45, the hollow piston 20 and the joining member 18. Piston 20 is screwed together with joining member 18, and is connected with the centering member 45 by a close adaptation of the play and under the effect of force from the third helical spring 8, <sup>forming</sup> configured as the third flexible element. Piston 20 is supported by <sup>spring 8</sup> means of third helical spring 8, which is supported at one end on the glass shield 24 and on the other end on centering member 45, <sup>and is</sup> prebiased in the direction of the rivet 14 <sup>illustrated</sup> represented at the left edge of the drawing.

Piston 20 is guided in first cylinder 22 by a guiding ring 13 and a first packing/sealing combination 12 and is sealed. <sup>Via</sup> On hydraulic connection 69, hydraulic power fluid is guided through an annular groove and corresponding bores into the first guide bushing 26 on a retaining ring 5 and into the hollow cylindrical volume between first cylinder 22 and piston 20, and piston 20 can be moved with corresponding pressure <sup>stress application</sup> of for example, 200 Bar counter to effect of third helical spring 8 in first cylinder 22. Another hydraulic connection of first

cylinder 22 is plugged blind by the first screw 56. Piston 20 is guided and sealed by a second seal-forming combination 11 and a third O-ring 10 arranged axially adjacent to that arrangement on the rivet-side end of first cylinder 22. The seal-forming combinations 11, 12, 35 are of multiple parts and have a plastic part with a packing washer and a O-ring mounted thereunder.

Piston 20 is screwed together with the joining member 18 with use of a locknut 19. ~~Into firing~~  
channel 70 <sup>is</sup> formed by aligned boreholes in piston 20 and ~~connecting piece~~ <sup>joining member</sup> 18, ~~is guided~~ <sup>and receives</sup> a striking member 21. ~~which~~ <sup>Striking member 21</sup> is prebiased in the direction of rivet 14 by the first helical spring 51 embodied as first flexible element. First helical spring 51 is ~~thus~~ supported in the direction of housing 1 on an annular shoulder formed in the firing channel by piston 20, and is supported in the direction of rivet 14 on striking member 21. Striking member 21 at its end turned toward first helical spring 51 likewise has an annular shoulder, formed by building up of a cylindrical extension with a small diameter, on which is supported first helical spring 51.

Striking member 21 can be configured of one or more pieces, especially of two pieces. In the case of a two-piece configuration, striking member 21 can ~~consist of~~ <sup>comprise</sup> a jacket and a pin introduced into the jacket and connected securely with it, ~~which~~ <sup>The</sup> pin has a smaller diameter, a greater length and a higher flexibility module and/or a greater hardness than the jacket. The secure connection between jacket and pin can be executed, for example, by welding, extrusion or by use of adhesive. The diameter of the jacket is adapted to the diameter of firing channel 70, while the diameter of the pin is adapted to the diameter of the rivet pin 14b.

In the position shown in the drawing, striking member 21 engages ~~on~~ a buffer element 49 arranged at the end of firing channel 70. Firing channel 70 is open through a borehole in joining member 18 to rivet 14, ~~whereby~~ <sup>with a</sup> in the exemplary embodiment shown in the drawing the striking member 21 has a first segment 21a ~~of which the~~ diameter is adapted to the diameter of firing

<sup>guiding</sup>  
channel 70 and by means of which striking member 21 is guided in firing channel 70, and also, <sup>the striking member 21 with</sup>  
has a second segment 21b, of which the smaller diameter is adapted to the diameter of the bore in joining member 18 or to the diameter of rivet pin 14b.

<sup>or sleeve</sup>  
Joining member 18 is sealed in and guided within a guiding jacket 16, <sup>Guiding Jacket 16 is</sup> screwed together with first cylinder 22, with a second O-ring 9 inserted in an annular groove <sup>in the joining member</sup>. Furthermore, a clamp sheathing 4 is screwed together with joining member 18, <sup>Clamp 4</sup> which sheathing surrounds clamping jaws 3 arranged around rivet pin 14b, and <sup>is received in</sup> likewise is guided into the guiding sleeve 16. Clamping jaws 3 are spread at their end turned toward housing 1 by means of a pressure sheathing 17, <sup>Sheathing 17</sup> which is prebiased under the effect of a second helical spring 7 arranged between pressure sheathing 17 and joining member 18 in the direction of rivet 14, <sup>and</sup> at its end turned toward rivet 14, <sup>Jaws 3 are</sup> spread apart by means of an end piece 15 screwed into guiding <sup>sleeve</sup> 16. The spreading then is executed by form-locking contact of conical contact surfaces of clamping jaws 3 and pressure sheathing 17 or end piece 15.

<sup>Fig. 1</sup>  
Second segment 21b of striking member 21 projects into the position represented in the drawing through the bore of joining member 18 and a bore in pressure sheathing 17 until it reaches between clamping jaws 3 and engages ~~on~~ rivet pin 14b of rivet 14. At its end adjacent to rivet pin 14b, second segment 21b is shaped in a synclinal depression serving as centering device for rivet pin 14b.

Guiding sleeve 16 is surrounded by a centering sleeve 54, <sup>having</sup> which has an opening in alignment with the borehole in end piece 15 to receive rivet pin 14b. Centering sleeve 54 is tightly <sup>connected thereto, preferably by welding.</sup> connected over first screw 52 and centering sleeve 54 <sup>are threadably received in nuts 54 to couple</sup> to the second rod 57, preferably welded <sup>first</sup> and to <sup>to</sup> thereto, nuts 53 connect with a first rod 55 and a second rod 57, <sup>has a nut 53</sup> while rod 57 acts on a switch element of the device in such a manner that the firing process cannot be triggered until the

centering sleeve 54 is moved by a suitable contact force on the device with contact of rivet 14 to the workpieces to be joined, <sup>The contact force moves</sup> as well as to centering sleeve 54, ~~moving~~ axially in the direction of housing 1 <sup>on</sup> through guiding sleeve 16 ~~and engages thereon~~. <sup>by</sup> Thus ~~both~~ the risk of injury by firing of a rivet without suitable contact on a workpiece and ~~also blank firing~~ and the risk of damage to the device connected therewith are effectively minimized.

Fig. 2 shows a section through the handle 71 of the device of the <sup>present</sup> invention. ~~Through the~~ Compressed air connection 68 <sup>S</sup> the device ~~is~~ supplied with compressed air, for example, at 7 Bar pressure. The process of firing and pulling is controlled by ~~means of~~ a pneumatic switch element surrounding the firing valve 59, pulling valve 60 and outlet 61. The active pneumatic/hydraulic pressure converter during the pulling of the rivet is triggered ~~by means of a (not shown) connection~~ between pulling valve 60 and input connection 67 in the covering 34 <sup>at</sup> with compressed air. The ~~not shown~~ connection can, for example, be realized through compressed air tubes guided outside of the handle or by compressed air tubes or compressed air channels guided within the handle.

Covering 34 furthermore surrounds a rapid evacuation valve, <sup>The rapid evacuation valve</sup> which includes a sliding seal 48, and a member 46 sealed by ~~means of~~ a ninth O-ring 64 and having an axial borehole. On the output side of the rapid evacuation valve, <sup>is</sup> ~~is provided~~ a screen 47, secured with a second security ring 63, ~~in order~~ to prevent contamination of the rapid evacuation valve. Connection of the rapid evacuation valve with the second cylinder 32 of the pneumatic/hydraulic pressure converter is provided through a borehole in covering 34. Covering 34 is connected, with use of a sealing flange 33 screwed together with it and seventh and eighth O-rings 39 and 62, <sup>to</sup> with the second cylinder 32.

Within second cylinder 32, <sup>and</sup> ~~is arranged~~ a pneumatic piston 31, which is sealed off from the wall of second cylinder 32 by ~~means of~~ a sixth O-ring 38 introduced into an annular groove. A piston

in piston 31



rod 27 is connected with pneumatic piston 31, and with use of a third sealing combination 35 and a fifth O-ring 37, piston rod 27 moves through a flange 30 and enters into a hollow space 66 filled with a hydraulic fluid. Piston rod 27 is also guided by a guiding bushing 29 arranged between guiding flange 30 and handle 71. With an upward movement of pneumatic piston 31 and ~~concomitantly with the piston rod 27 movement being reversed~~, the pneumatic pressure at the input connection 67 is converted into hydraulic pressure in hollow space 66. The hydraulic pressure is guided through output connection 65 to the hydraulic connection 69 shown in Fig. 1. The (not shown) pressure guide on the hydraulic side can in turn, for example, be guided by pressure lines from outside the handle or the device can be realized by pressure lines or pressure channels guided within the device.

Guiding flange 30 is screwed by means of the second screw 40 together with handle 71 with use of a fourth O-ring 36 and sealed tightly. ~~At the same time~~ <sup>by</sup> means of exterior threading, flange 30 is screwed together with the second cylinder 32. ~~Furthermore,~~ <sup>A</sup> an annular second buffer 44 is provided on flange 30 for the buffering of pneumatic piston 31 in the case of an upward movement.

The following functions take place during the production of a riveted joint. ~~First, of all~~ <sup>First</sup> as shown in Fig. 1, a rivet is introduced into the device until rivet pin 14b engages ~~on~~ striking member 21. In this state, the firing process has not yet been triggered, since the centering sleeve 54 in the position shown in Fig. 1 does not yet release or disengage from the pneumatic switch element 59, 60, 61. <sup>when</sup> ~~Finally~~ the device having rivet pin 14b is pressed against the workpiece to be joined, ~~Then~~ rivet pin 14b is first introduced counter to the effect of the first helical spring 51 by the clamping jaws 3 in the opening of joining member 18, and ~~thus~~ the striking member 21 is pressed to the rear in firing channel 70. The striking head 14e of rivet sleeve 14a <sup>then</sup> ~~thus~~ comes into contact with centering sleeve 54 and moves this sleeve with further pressing in the direction of guiding

sleeve 16, whereupon the pneumatic switch element 59, 60, 61 is disengaged by ~~means of~~ the first and second rods 55, 57.

During the operation of the first switch step, firing bolt 25 is slipped forward by centrifugal action and impacts on striking member 21, which then acts on rivet pin 14b and fires rivet 14 into the workpieces to be joined. The forward movement of striking member 21 is then buffered by the buffer element 49 within firing channel 70.

With further pulling through of the outlet 61 shown in Fig. 2, by means of the pulling-valve 60, the pneumatic/hydraulic pressure converter is acted upon with compressed air coming through input connection 67. The seal 48 thus engages on insert member 46 and frees the passage of compressed air on pneumatic piston 31, which is moved upward and builds up a pressure in the hollow space 66 over piston rod 27, ~~and the~~ <sup>hydraulic</sup> pressure is fed through the output connection 65 to hydraulic connection 69 shown in Fig. 1.

The hydraulic pressure works on piston 20 and presses it counter to the force of third helical spring 8 in the direction of housing 1. Thus clamp sheathing 4 is also pulled in the direction of housing 1 and clamping jaws 3 engage rivet pin 14b tightly and tear it rearward to a predetermined break point. With release of outlet 61, the input connection 67 shown in Fig. 2 is without pressure, whereupon the seal 48 of member 46 drops away and the passage for the compressed air is released from second cylinder 32 through member 46 and screen 47 leading to the outside environment. Second cylinder 32 is then without pressure. Under the effect of third helical spring 8, piston 20 <sup>is then moved</sup> ~~in its original setting is pressed~~ in the direction of rivet 14, ~~and through~~ hydraulic connection 69 and output connection 65, piston rod 27 and ~~along with that~~ <sup>are</sup> pneumatic piston 31 <sup>are</sup> moved back into ~~its~~ <sup>their</sup> bottom original position <sup>s</sup>. Simultaneously, by the movement of piston 20 in the direction of rivet 14 by means of second segment 21b of striking member 21, the

torn away rivet pin 14b is thrown out forward by clamp sheathing 4 and guiding sleeve 16. The device is now ready for the insertion of another rivet and for the repeated production of a riveted joint.

The mechanism of pneumatic switch elements 59, 60, 61 and of second rod 57 arranged in working connection with the switch is designed so that firing bolt 25 following an act of firing preferably returns to its original setting and multiple triggerings of the pulling process without cyclical firing processes is possible, as long as the machine has not been removed from the workpieces to be joined. This <sup>operation</sup> advantageously allows for multiple pullings of a rivet which has been fired in, and therefore increases both the reliability and the operational security of the device.

Fig. 3 shows a diagrammatic and partially sectioned total view of the device of the invention. The position of rivet 14 <sup>relative</sup> ~~which is shown in relation~~ to centering sleeve 54 and <sup>present</sup> ~~therefore thus~~ on the head of the device corresponds to the representation of Fig. 1. The position of pneumatic piston 31 in handle 71 corresponds to the representation in Fig. 2. The compressed air conduit 72 is represented by a broken line between the pulling valve 60 and the input connection 67. The hydraulic pressure line 73 is represented by a broken line between output connection 65 and hydraulic connection 69.

Fig. 4 shows a rivet for use in the device of the invention. Rivet 14 is constructed in two parts, ~~and has~~ a rivet jacket 14a and a rivet pin 14b. Rivet pin 14b is provided at its first end directed to the workpieces to be joined with a point 14c and with cutting edges 14d. <sup>The</sup> ~~Having a~~ pyramid shape of the first end of rivet pin 14b <sup>is</sup> ~~has been shown as~~ especially advantageous, whereupon all four cutting edges 14d are formed. Rivet pin 14b is surrounded in segments by rivet jacket 14a, whereby rivet jacket 14a on its end more distant from point 14c is configured as mushroom-shaped and forms a striking head 14e. At the end 14g opposite this point 14c, rivet pin 14b is

likewise configured preferably in pyramid shape, in order to guarantee reliable centering in relation to the striking member 21.

With the firing of rivet 14, rivet pin 14b together with rivet jacket 14a is driven sufficiently far into the workpieces ~~which are~~ <sup>the surface of one</sup> to be joined until striking head 14e engages on a workpiece ~~to be joined~~. ~~In order~~ to prevent penetration of rivet pin 14b, rivet pin 14b has catching means in the area of rivet jacket 14a directed in the direction of the point 14c of rivet 14. These means can for example be formed by saw-toothed, rolled-in annular grooves, whereby the sawtooth shape is aligned so that during the firing of rivet 14 rivet pin 14b hooks into the rivet jacket. In the area of this catching means, rivet jacket 14a is connected tightly with rivet pin 14b, for example is extruded, soldered, cemented or welded with it. Therefore rivet pin 14b in the area of rivet jacket 14a has a predetermined break point 14f, from which rivet pin 14b tears away during pulling of rivet 14.

⑤ →

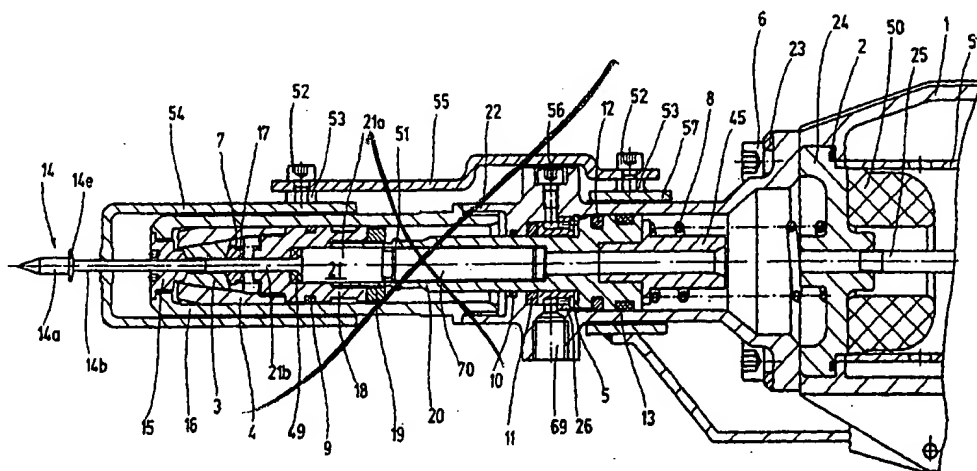
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<p>(21) Internationales Aktenzeichen: PCT/EP99/03862</p> <p>(22) Internationales Anmeldedatum: 4. Juni 1999 (04.06.99)</p> <p>(30) Prioritätsdaten: 198 26 157.8      12. Juni 1998 (12.06.98)      DE</p> <p>(71) Anmelder (für alle Bestimmungsstaaten außer US): WIRTH MASCHINENBAU GMBH (DE/DE); Brehmer Strasse 1, D-06188 Landsberg (DE).</p> <p>(72) Erfinder; und (75) Erfinder/Anmelder (nur für US): RÖTHE, Sven (DE/DE); Coswiger Landstrasse 13, D-06886 Lutherstadt Wittenberg (DE). WIRTH, Klaus (DE/DE); Hopfenstrasse 15, D-88069 Tettnang (DE).</p> <p>(74) Anwalt: BARTELS &amp; PARTNER; Lange Strasse 51, D-70174 Stuttgart (DE).</p>		<p>(81) Bestimmungsstaaten: JP, US, europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</p> <p>Veröffentlicht Mit internationalem Recherchenbericht.</p>

~~(54) Title: DEVICE FOR PRODUCING A RIVETED JOINT AND CORRESPONDING RIVET~~

~~(54) Bezeichnung: VORRICHTUNG ZUR HERSTELLUNG EINER NIETVERBINDUNG UND ZUGEHÖRIGER NIET~~



~~(57) Abstract of the Disclosure~~

~~The invention relates to a device for producing a riveted joint comprising means (21, 25) to fire a rivet (14) having a jacket (14a) and a pin (14b) guided through the jacket (14a) through the work piece to be joined and means for pulling the rivet (14). The invention aims at providing a device that can be manufactured at a reasonable price and that ensures reliable operation. This is achieved in that the means (21, 25) for firing the rivet (14) act upon the rivet pin (14b).~~

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